

WHAT IS CLAIMED IS:

1. A liquid crystal display device, comprising a first substrate, a second substrate and a liquid crystal layer interposed between the first substrate and the second substrate, wherein:

5 a plurality of picture element regions are provided each of which is defined by a first electrode provided on one side of the first substrate which is closer to the liquid crystal layer and a second electrode provided on the second substrate so as to oppose the first electrode via the liquid crystal layer;

10 the liquid crystal layer is a vertical alignment type liquid crystal layer containing a liquid crystal material having a negative dielectric anisotropy; and

15 each of the plurality of picture element regions includes at least one orientation-regulating region, the orientation-regulating region including a first region in which an electric field applied across the liquid crystal layer by the first electrode and the second electrode has a first electric field strength, a second region in which the electric field has a second electric field strength which is smaller than the first electric field strength, and a third region in which the electric field has a third electric field strength which is smaller than the second electric field strength, wherein the first, second and third regions are arranged in this order in a predetermined direction.

20

25 2. The liquid crystal display device of claim 1, wherein a boundary between the first region and the second region and a boundary between the second region and the third region extend

in a direction perpendicular to the predetermined direction.

3. The liquid crystal display device of claim 1, wherein
each of the plurality of picture element regions includes a
plurality of orientation-regulating regions, the plurality of
5 orientation-regulating regions having the same direction of
arrangement of the first, second and third regions.

4. The liquid crystal display device of claim 1, wherein
each of the plurality of picture element regions includes a first
orientation-regulating region in which the first, second and third
regions are arranged in this order in a first direction, and a
second orientation-regulating region in which the first, second
and third regions are arranged in this order in a second direction
which is different from the first direction.

5. The liquid crystal display device of claim 4, wherein
each of the plurality of picture element regions includes a
plurality of at least one of the first orientation-regulating
region and the second orientation-regulating region.

6. The liquid crystal display device of claim 4, wherein
the first direction and the second direction are opposite to each
20 other.

7. The liquid crystal display device of claim 6, each of
the plurality of picture element regions further including a third
orientation-regulating region in which the first, second and third
regions are arranged in this order in a third direction which is
25 different from the first and second directions, and a fourth
orientation-regulating region in which the first, second and third

regions are arranged in this order in a fourth direction which is different from the first, second and third directions, wherein the third and fourth directions are perpendicular to the first and second directions.

5 8. The liquid crystal display device of claim 4, wherein the first orientation-regulating region and the second orientation-regulating region share at least one of the first region and the third region.

10 9. A liquid crystal display device, comprising a first substrate, a second substrate and a liquid crystal layer interposed between the first substrate and the second substrate, wherein:

15 a plurality of picture element regions are provided each of which is defined by a first electrode provided on one side of the first substrate which is closer to the liquid crystal layer and a second electrode provided on the second substrate so as to oppose the first electrode via the liquid crystal layer;

the liquid crystal layer is a vertical alignment type liquid crystal layer containing a liquid crystal material having a negative dielectric anisotropy; and

20 each of the plurality of picture element regions includes at least one orientation-regulating region, the orientation-regulating region including a first region in which the first electrode and the second electrode have a first inter-electrode distance therebetween, a second region in which the first electrode and the second electrode have a second inter-electrode distance therebetween which is greater than the

first inter-electrode distance, and a third region in which the first electrode and the second electrode have a third inter-electrode distance therebetween which is greater than the second inter-electrode distance, wherein the first, second and
5 third regions are arranged in this order in a predetermined direction.

10. The liquid crystal display device of claim 9, wherein a boundary between the first region and the second region and a boundary between the second region and the third region extend in a direction perpendicular to the predetermined direction.

11. The liquid crystal display device of claim 9, wherein each of the plurality of picture element regions includes a plurality of orientation-regulating regions, the plurality of orientation-regulating regions having the same direction of arrangement of the first, second and third regions.
15

12. The liquid crystal display device of claim 9, wherein each of the plurality of picture element regions includes a first orientation-regulating region in which the first, second and third regions are arranged in this order in a first direction, and a second orientation-regulating region in which the first, second and third regions are arranged in this order in a second direction which is different from the first direction.
20

13. The liquid crystal display device of claim 12, wherein each of the plurality of picture element regions includes a plurality of at least one of the first orientation-regulating region and the second orientation-regulating region.
25

TOSHIBA CORPORATION

14. The liquid crystal display device of claim 12, wherein
the first direction and the second direction are opposite to each
other.

15. The liquid crystal display device of claim 14, each
5 of the plurality of picture element regions further including a
third orientation-regulating region in which the first, second
and third regions are arranged in this order in a third direction
which is different from the first and second directions, and a
fourth orientation-regulating region in which the first, second
10 and third regions are arranged in this order in a fourth direction
which is different from the first, second and third directions,
wherein the third and fourth directions are perpendicular to the
first and second directions.

16. The liquid crystal display device of claim 12, wherein
the first orientation-regulating region and the second
15 orientation-regulating region share at least one of the first
region and the third region.

17. A liquid crystal display device, comprising a first

substrate, a second substrate and a liquid crystal layer interposed
20 between the first substrate and the second substrate, wherein:

a plurality of picture element regions are provided each
of which is defined by a first electrode provided on one side of
the first substrate which is closer to the liquid crystal layer
and a second electrode provided on the second substrate so as to
25 oppose the first electrode via the liquid crystal layer;

the liquid crystal layer is a vertical alignment type

liquid crystal layer containing a liquid crystal material having a negative dielectric anisotropy;

the first electrode includes a lower conductive layer, a dielectric layer covering the lower conductive layer, and an upper conductive layer provided on one side of the dielectric layer which is closer to the liquid crystal layer;

the upper conductive layer includes an upper layer opening for each of the plurality of picture element regions, and the lower conductive layer includes a lower layer opening for each of the plurality of picture element regions; and

each of the plurality of picture element regions includes at least one orientation-regulating region, the orientation-regulating region including a first region in which the liquid crystal layer is arranged between the upper conductive layer of the first electrode and the second electrode, a second region in which the liquid crystal layer and the dielectric layer located within the upper layer opening are arranged between the lower conductive layer of the first electrode and the second electrode, and a third region in which the liquid crystal layer and the dielectric layer located within the upper layer opening are arranged between the lower layer opening of the first electrode and the second electrode, wherein the first, second and third regions are arranged in this order in a predetermined direction.

18. The liquid crystal display device of claim 17, wherein each of the upper layer opening and the lower layer opening has a side extending in a direction perpendicular to the predetermined

DRAFTED BY D. S. T. 10/20/2010

direction, and a boundary between the first region and the second region and a boundary between the second region and the third region extend in parallel to the side.

19. The liquid crystal display device of claim 17, wherein
5 a boundary between the first region and the second region and a boundary between the second region and the third region extend in a direction perpendicular to the predetermined direction.

20. The liquid crystal display device of claim 17, wherein
10 in each of the plurality of picture element regions, one surface of the first substrate which is closer to the liquid crystal layer is substantially flat.

21. The liquid crystal display device of claim 17, wherein
in each of the plurality of picture element regions, the liquid
15 crystal layer has a substantially constant thickness.

22. The liquid crystal display device of claim 17, wherein
each of the plurality of picture element regions includes a plurality of orientation-regulating regions, the plurality of orientation-regulating regions having the same direction of
20 arrangement of the first, second and third regions.

23. The liquid crystal display device of claim 17, wherein
each of the plurality of picture element regions includes a first
orientation-regulating region in which the first, second and third
regions are arranged in this order in a first direction, and a
second orientation-regulating region in which the first, second
25 and third regions are arranged in this order in a second direction
which is different from the first direction.

PCT/EP2010/002460

24. The liquid crystal display device of claim 23, wherein each of the plurality of picture element regions includes a plurality of at least one of the first orientation-regulating region and the second orientation-regulating region.

5 25. The liquid crystal display device of claim 23, wherein the first direction and the second direction are opposite to each other.

10 26. The liquid crystal display device of claim 25, each of the plurality of picture element regions further including a third orientation-regulating region in which the first, second and third regions are arranged in this order in a third direction which is different from the first and second directions, and a fourth orientation-regulating region in which the first, second and third regions are arranged in this order in a fourth direction which is different from the first, second and third directions, wherein the third and fourth directions are perpendicular to the first and second directions.

15 27. The liquid crystal display device of claim 23, wherein the first orientation-regulating region and the second orientation-regulating region share at least one of the first region and the third region.

20 28. The liquid crystal display device of claim 17, wherein each of the upper layer opening and the lower layer opening has a polygonal shape or a circular shape, with the lower layer opening 25 being provided within the upper layer opening.

29. The liquid crystal display device of claim 17, wherein

the upper conductive layer and the lower conductive layer are electrically connected to each other.

30. The liquid crystal display device of claim 17, wherein the first electrode is a picture element electrode which is provided for each of the plurality of picture element regions, and a voltage is applied to the first electrode via an active element which is provided for each of the plurality of picture element regions.

31. The liquid crystal display device of claim 30, wherein the second electrode is a single counter electrode which is provided commonly for the plurality of picture element regions.

32. The liquid crystal display device of claim 17, wherein:
the plurality of picture element regions are arranged in a matrix pattern having rows and columns;
the first electrode is provided as a plurality of electrodes which are arranged in a stripe pattern corresponding to the columns; and

the second substrate includes a thin dielectric plate, an insulative substrate, and a plurality of plasma channels which are arranged in a stripe pattern corresponding to the rows between the thin dielectric plate and the insulative substrate, and the second electrode is provided as a plurality of virtual electrodes respectively formed by corresponding regions of the thin dielectric plate respectively opposing the plurality of plasma channels which are arranged in a stripe pattern.